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A FLORISTIC DESCRIPTION AND STRUCTURAL ANALYSIS OF THE PLANT COMMUNITIES OF THE PUNDA MILIA—PAFURI—WAMBIYA AREA IN THE KRUGER NATIONAL PARK, REPUBLIC OF SOUTH AFRICA:

1. THE HYGROPHILOUS COMMUNITIES

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Abstract

The topography, drainage, geology, soils, climate and biotic factors of the study area, situated in the northern part of the Kruger National Park, are discussed. The floristic classification of the vegetation was done by means of the Braun-Blanquet method whereas the Variable Quadrant Plot method was used for the structural analysis. The vegetation was divided into three main groups, namely the Hygrophilous, the Sandveld and the *Colophospermum mopane* communities. A floristic description of the Hygrophilous communities is included in this paper.

Uittreksel

'N FLORISTIESE BESKRYWING EN STRUKTURELE ANALISE VAN DIE PLANTGEMEENSKAPPE VAN DIE PUNDA MILIA—PAFURI—WAMBIYA GEBIED IN DIE NASIONALE KRUGERWILDTUIN, REPUBLIEK VAN SUID-AFRIKA: 1. DIE HIGROFILIESE GEMEENSKAPPE

Die topografie, dreinering, geologie, grond, klimaat en biotiese faktore van die studiegebied, wat in die noordelike gedeelte van die Nasionale Krugerwildtuin geleë is, word bespreek. 'n Floristiese plantegroeiklassifikasie is met behulp van die Braun-Blanquetmetode daargestel, terwyl die strukturele analise met behulp van die Varieerbare Kwadrantperseelmetode gedoen is. Die plantegroei is in drie hoofgroepe ingedeel, naamlik die Higrofiliese-, Sandveld- en *Colophospermum mopane*-gemeenskappe. 'n Floristiese beskrywing van die Higrofiliese gemeenskappe word in hierdie artikel gegee.

Introduction

It is a well-established fact that nature reserves have to be managed and Edwards (1976) states that: "The kind and degree of control necessary, depends on the three main purposes of nature reserves: to conserve species and ecosystems; to preserve the natural aesthetic character of the landscape; and to satisfy certain needs of what may broadly be termed the public."

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The Kruger National Park was created primarily to conserve the animal and plant life of the area (Van der Schijff, 1957). The conservation of the animal life in an area is impossible without the conservation of the area's plant life. To achieve this aim sound conservation and management policies are essential (Edwards, 1972). These must be based on a thorough knowledge of the ecosystem which should include a detailed classification of the vegetation of the area.

According to Van Wyk (1972) the first records of plants collected in the Kruger National Park date back to the previous century. Herbert Lang collected approximately 300 species during 1932, while C. Letty and A. A. Obermeyer also collected plants during the 1930's. In more recent years plant collections and/or descriptions of the vegetation of the northern part of the Kruger National Park have been made by Codd (1951), Acocks (1975), Van der Schijff (1957, 1969), Brynard (1961), Van Wyk (1971, 1972, 1974) and Werger and Coetzee (1977).

The necessity of a floristic-structural classification of the vegetation in the Kruger National Park has however only gained importance in the past few years because it has now become increasingly evident that such information can contribute to the formulation of sound conservation and management programmes. The main object of this study therefore was to provide a floristic-structural classification and description of the woody vegetation of the Punda Milia-Pafuri-Wambiya area and where possible to correlate the vegetation types with environmental factors. The results are recorded in a series of three papers of which this is the first.

STUDY AREA

Location

The study area is situated in the Kruger National Park between 22° 20′ and 22° 45′ latitude and 30° 55′ and 31° 25′ longitude and is bordered by Zimbabwe to the north and by Mozambique to the east (Fig. 1). The area is divided into the following regions:

(a) the Punda Milia area, which is situated north of 22° 45′ latitude, up to the Levubu River in the north and west of the tarred road between Punda Milia and Pafuri;

(b) the Pafuri area, which includes the land between the Levubu and Limpopo Rivers and south to the Caborra Bassa-Apollo power lines, east of the tarred road; and

(c) the Wambiya area, from the 22° 45′ latitude to the Caborra Bassa-Apollo power lines in the north, east of the tarred road.

The study area covers approximately 1 586 km^2. The longest distance in a north-south direction is almost 46 km, whereas the longest distance in an east-west direction is approximately 53 km.

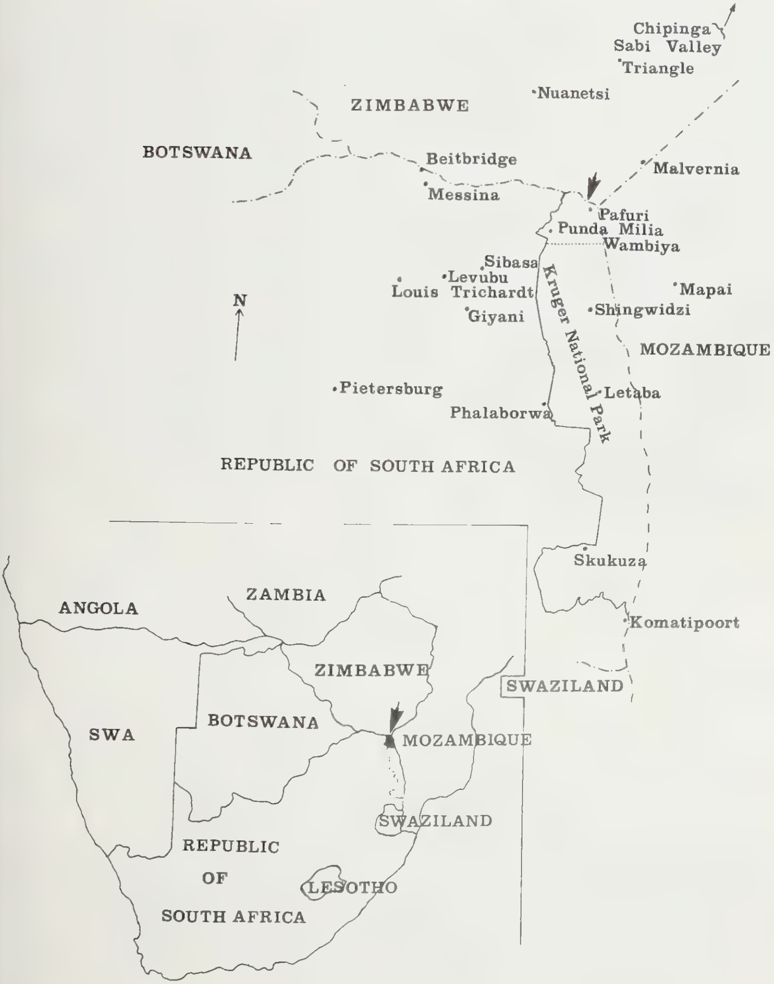


FIG. 1.
Location of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park

Topography

The study area lies between 197 and 643 m above sea level and includes mountains, hills and plains. The prominent hills around Punda Milia form part of the eastern foothills of the Soutpansberg mountain range. A number of valleys which run from east to west, occur between the hills to the west and north of Punda Milia. The rivers and streams in these valleys all flow towards the Levubu River which forms the western border of the study area. On its way to the Limpopo River, the Levubu has carved a deep gorge through the Waterberg Sandstone as well as the Cave Sandstone Formations. In some places the cliffs on either side of the Levubu River reach 185 m in height and are especially striking at Lanner Gorge west of Pafuri. Schutte (1974) described the areas underlain by Cave Sandstone of the Karroo System, as among the most picturesque in the Kruger National Park. From Xantangelane northwards, the Cave Sandstone appears typically as outcrops or as inselbergs on basalt plains, although the basalt is stratigraphically higher than the Cave Sandstone.

The areas underlain by shale and basalt (Fig. 2), are generally flat or undulating and the landscape is dominated by *Colophospermum mopane* shrubs. Between the Levubu and Limpopo Rivers however, the basalt forms prominent northwest-southeast running hills.

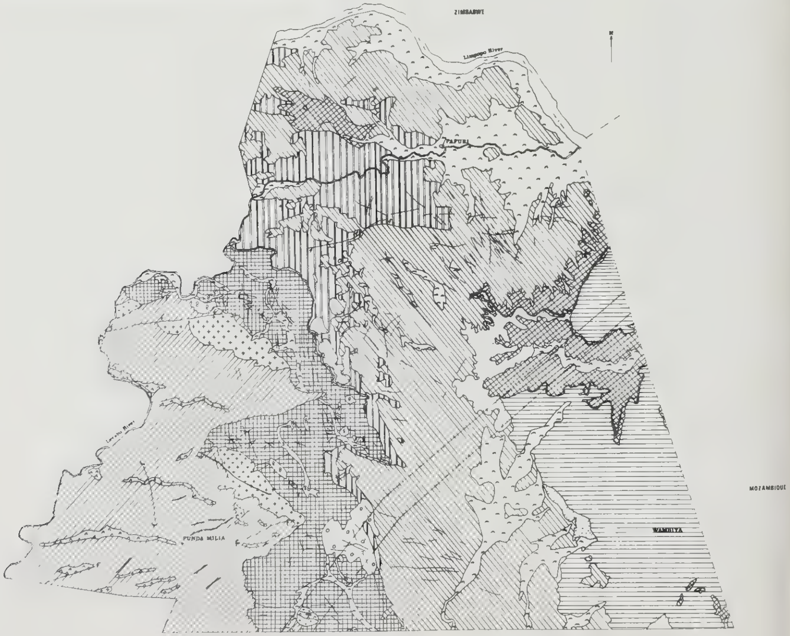


FIG. 2.
Geological map of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park (Drawn after Schutte, 1974).

LEGEND

1:490 000 (approx.)

〰	ALLUVIUM			QUATERNARY
○	SOIL			
☰	LIGHT RED AND WHITE SAND			
⁙	GRAVEL, SOIL			
▩	CONGLOMERATE, MERREL, FLESH COLOURED TO WHITE SANDSTONE		MALVERNIA FORMATION	CRETACEOUS ?
8	DOLORITE (DYKES, SILLS)			POST KARROO INTRUSIONS
▧	BASALT, LIMBURGITE	DRAKENSBERG STAGE	STORMBERG SERIES	KARROO SYSTEM
▥	FINELY TEXTURED SANDSTONE	CAVE SANDSTONE STAGE		
▨	MUDSTONE, CHERT	RED BEDS STAGE		
▦	SHALE WITH COAL SEAMS, MUDSTONE AND GRIT DEPOSITS		ECCA SERIES	
^	DIABASE			POST WATERBERG INTRUSIONS
⁄	DIABASE OR DOLORITE DYKE (MINOR FAULT)			
▨	SANDSTONE, QUARTZITE WITH INTERBEDDED ANDESITE			WATERBERG SYSTEM
+	ANDESITE WITH TUFF, INTERBEDDED SANDSTONE AND QUARTZITE			
⌁	FAULT			
〰	ESCARP			
⁄	POWER LINE			
— · —	INTERNATIONAL BORDER			

The Malvernia Formation at Malonga on the eastern border forms two plateaus on either side of the Shilalandonga stream. Due to a strong run-off from the plateaus to the donga, this area is severely eroded. On the plateaus themselves drainage is poor and a large number of pans occur. The sandy plateau at Shirombe has an altitude of 520 m above sea level while the basalt plains west of Shirombe are situated approximately 400 m above sea level. Broad flood plains are found along some of the streams and they are especially well developed along the Limpopo and Levubu Rivers.

Drainage

The study area is drained mainly by the Limpopo and Levubu Rivers and their tributaries such as the Madzaringwe, as well as a number of streams such as the Shilahlandonga, Shisha and Hlamalala. The most important perennial fountains are at Shipudza, Matukwale, Malonga, Tshalungwa and Klopperfontein. In the southern part of the study area along the Hlamalala, Shisha and Nwashitsumbe streams, dambos are found where, due to poor drainage, waterlogged conditions often exist.

Geology and Soils

The discussion of the geology of the study area (Fig. 2) is based on the description by Schutte (1974). In the vicinity of Punda Milia a period of intense andesitic vulcanism was followed by the deposition of sedimentary rock (sandstone and shale). At a later stage sills and dykes were formed in the rock of the Waterberg System by the intrusion of diabase. Sandstone, quartzite, underlying conglomerate and shale occur as outcrops from the Punda Milia Gate in the south to Madzaringwe in the north. The prominent hills near Punda Milia, e.g. Gumbandebvu, Thula Mila and Shitshova consist of sedimentary rock (Schutte, 1974). In the study area the Karroo System is present as

(a) basalt; and sandstone of the Cave Sandstone Stage,
(b) mud stone of the Red Beds Stage and
(c) shale of the Ecca Serie.

The Ecca Serie consists of shale in which deposits of coal, mud stone and grit stone occur. This Serie forms outcrops from Madzaringwe in the north to Dzundwini and beyond in the south. Rocky outcrops of the Cave Sandstone Stage appear from the Limpopo southwards to beyond Xantangelane. Basalt and limburgite of the Drakensberg Stage occur as a broad strip which is bordered on the west by Cave Sandstone. In the east it is fringed by the Malvernia Formation and more recent sand deposits. The basalt stretches from the Limpopo River southwards to Shingwidzi.

The Malvernia Formation consists of conglomerate, calcareous sandstone, merrel and consolidated gravel (Keyser, 1972; Schutte, 1972, 1974). The sedimentary rock of the Malvernia Formation has been eroded by the Limpopo and Levubu Rivers at two localities within the study area, namely at Matulekop and Shilahlandonga and at Malvernia in southeastern Zimbabwe (Cox, 1963).

The Wambiya area on both sides of the Shilahlandonga is characterised by flesh coloured to white sandstone and aeolian sand that were deposited on the Malvernia Formation during dry climatic periods. The most recent deposits are alluvial soils. Along the Levubu and Limpopo Rivers wide alluvial flood plains occur in which a few pans are located which are periodically filled by floods.

A reconnaissance soil map (Fig. 3) of the northern Kruger National Park was compiled by Harmse, Van Wyk and Gertenbach in 1973. From this map ten main regions can be distinguished within the study area, namely regions with:

(i) deep sandy soils mainly in the Wambiya area but also in part of the Punda Milia area;
(ii) sandy loam and clay soils mainly southeast of Punda Milia as well as in the Wambiya area;
(iii) red clay soils in the Punda Milia area and near Klopperfontein;
(iv) dark clay soils on the central plains up to the Levubu River in the north;
(v) medium to heavy soils with a pedocutanic B-horizon north of Punda Milia and west of Pafuri;
(vi) soils occurring in low-lying areas and along most of the streams in the Punda Milia area and on the flood plains along the Limpopo River;
(vii) dark clay soils in the low-lying areas occurring mainly on the alluvial flood plains in the Pafuri area;
(viii) flood plains and dikes in the Pafuri area;
(ix) shallow soils on granite and sandstone in the Punda Milia and Pafuri areas; and
(x) shallow calcareous soils and rock, covering large parts of the Punda Milia and Pafuri areas.

A striking correlation exists between the geology and soils of the study area as can be seen by comparing Figures 2 & 3.

Climate

According to Walter (1963) a strong correlation exists between climate and vegetation and Schulze and McGee (1977) stress the fact that the interactions between climatic factors such as light, temperature and rainfall can render the environment suitable for the development of a certain plant community. The temperature amplitudes for Pafuri and Punda Milia are 46,7 °C and 38,3 °C respectively and both extremely high temperatures (November) and relatively low temperatures (July) are experienced. In general the entire area can be regarded as being frost-free. Cyclones which move in sporadically from the

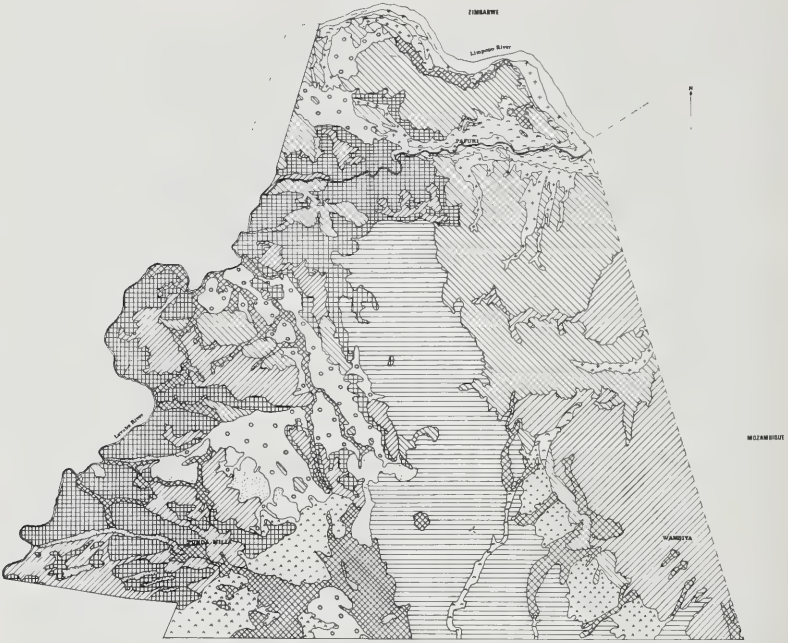


Fig. 3.
Soil map of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park (Drawn after Harmse, Van Wyk and Gertenbach, 1973.)

Mozambique canal influence the rainfall pattern and cause heavy downpours and floods.

According to the classification of the South African Weather Bureau (Schulze, 1965), the study area is part of the climatic region denoted as the Transvaal Lowveld (L). According to the Köppen index it has a BShw climate (Schulze, 1947), where BS = arid steppe climate; h = hot and dry with a mean annual temperature exceeding 18 °C; and w = dry winter. According to the classification of Thornthwaite the study area has a semi-arid, hot (steppe) climate described by the symbols DB′d (Schulze, 1947).

For the discussion of the climate, data from the Weather Bureaus of South Africa and Mozambique are used in Tables 1, 2 & 3 and Figure 4 (Weather Bureau, 1954, 1965; Reparticao tecnica de estatistica, 1961).

LEGEND

Scale 1:480 000

▨ DEEP SANDY SOILS

^ SANDY LOAM AND CLAY LOAM SOILS

⁘ RED CLAY SOILS

▤ DARK CLAY SOILS

○ MEDIUM TO HEAVY SOILS WITH A PEDOCUTANIC B-HORIZON

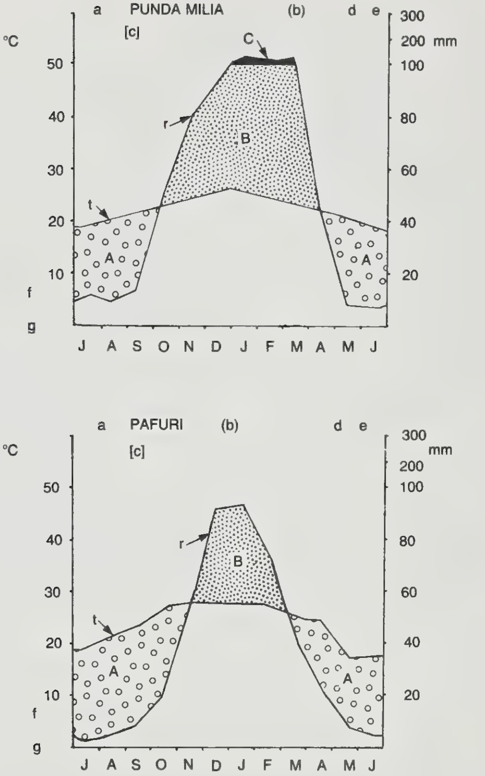
▩ SOILS WITH STRUCTURE OF THE LOW LYING AREAS AND DRAINAGE LINES

m DARK CLAY SOILS OF THE LOW LYING AREAS

+ FLOOD PLAINS AND DIKES

▦ SHALLOW SOILS ON GRANITE AND SANDSTONE

▧ SHALLOW CALCAREOUS SOILS AND ROCK



Symbols and explanations

		Punda Milia	Pafuri
a	Weather station	Punda Milia	Pafuri
(b)	Height above sea level (m)	462	290
[c]	Years of observation (First figure for temperature and second figure for rainfall)	10—21	10—23
d	Mean annual temperature (°C)	22,9	24,2
e	Mean annual rainfall (mm)	590	415,2
f	Mean daily minimum of the coldest month (°C)	11,4	8,1
g	Absolute minimum (°C)	5,0	0,8

A Dry period
B Humid period
C Per-humid period

t Mean monthly temperature
r Mean monthly rainfall

FIG. 4.
Climatic diagrams for Punda Milia and Pafuri (Walter and Lieth, 1960; Reparticao tecnica de estatistica, 1961).

Absolute temperatures are probably among the most important factors influencing the distribution of plant species (Van der Schijff, 1957; Schulze and McGee, 1977). Temperatures recorded for Punda Milia range from the absolute maximum of 43,3 °C in December to an absolute minimum of 5 °C in July, with a mean annual temperature of 22,9 °C. For Pafuri the values range from 47,5 °C (November) to 0,8 °C (July) with a mean annual temperature of 24,2 °C (Table 1).

TABLE 1.

Temperature data for Punda Milia (PM) and Pafuri (P) (Mozambique Station) according to the Weather Bureau (1954) and Reparticao tecnica de estatistica (1961)

		Temperature in °C for a 10 year period			
Month	Weather Station	Mean daily maximum	Mean daily minimum	Absolute daily maximum	Absolute daily minimum
January	PM	32,0	19,9	41,1	15,0
	P	33,9	21,4	42,9	13,5
February	PM	30,9	19,9	38,9	15,0
	P	33,8	21,7	44,0	15,5
March	PM	30,0	18,8	38,9	13,3
	P	33,5	20,1	42,2	7,0
April	PM	29,8	16,9	38,3	8,3
	P	32,7	17,3	40,6	10,5
May	PM	27,1	13,6	36,1	7,8
	P	30,7	12,3	40,9	3,8
June	PM	25,2	11,5	32,2	5,6
	P	27,7	8,9	36,3	1,2
July	PM	25,3	11,4	32,2	5,0
	P	28,1	8,1	36,4	0,8
August	PM	27,0	12,9	37,2	6,1
	P	30,1	10,5	39,5	1,0
September	PM	29,3	15,1	38,9	7,8
	P	31,8	14,9	43,5	3,9
October	PM	31,5	17,6	41,1	10,6
	P	34,4	18,9	46,7	8,7
November	PM	31,4	18,9	40,6	11,1
	P	34,1	20,4	47,5	11,6
December	PM	32,9	20,0	43,3	14,4
	P	34,5	21,2	43,5	14,4
Year	PM	29,4	16,4	43,3	5,0
	P	32,1	16,3	47,5	0,8

Punda Milia is situated at 462 m above sea level and has an average annual rainfall of 549,1 mm, whereas Pafuri (Mozambique) lies approximately 290 m above sea level and has an average annual rainfall of 415,2 mm (Table 2). The low-lying and relatively dry Limpopo Valley, in which the Pafuri area is situated, is a zone which is classified as a dry climatic type by Schulze and McGee (1977).

Table 2.

The mean monthly and annual rainfall, maximum and minimum monthly rainfall and the mean number of rainy days per month and year for Punda Milia (PM) and Pafuri (P) (Mozambique Station) (Weather Bureau, 1954, 1965; Pienaar, 1973)

Month	Weather Station	Rainfall (mm)				Mean number of rainy days per month
		Mean monthly rainfall	Monthly maximum rainfall	Monthly minimum rainfall	Maximum rainfall in 24 hours	
Period (years)		PM = 41 P = 48	PM = 21 P = 23	PM = 21 P = 23	PM = 17 P = 10	PM = 21 P = 46
January	PM	116,3	436,6	13,6	216,0	7,7
	P	91,0	442,3	2,4	82,9	6,1
February	PM	90,9	286,9	3,0	86,0	7,7
	P	71,2	142,2	—	96,6	5,9
March	PM	84,3	366,1	4,2	89,0	7,0
	P	43,2	120,4	—	43,7	4,8
April	PM	34,0	128,0	0,8	74,0	3,8
	P	21,1	100,3	—	52,0	2,1
May	PM	9,0	58,4	—	12,0	2,1
	P	7,1	54,8	—	10,6	1,2
June	PM	8,0	65,0	—	58,0	1,5
	P	5,3	33,1	—	26,5	1,1
July	PM	6,1	46,0	—	25,0	1,6
	P	1,3	14,0	—	5,8	0,9
August	PM	5,6	61,0	—	57,0	0,8
	P	3,7	6,5	—	0,3	0,9
September	PM	12,7	111,3	—	26,0	1,7
	P	8,5	92,5	—	55,0	1,1
October	PM	23,2	81,0	—	41,0	4,4
	P	17,7	55,3	1,0	26,5	2,4
November	PM	61,5	199,0	3,0	107,0	6,4
	P	56,0	103,0	2,5	57,9	4,9
December	PM	97,5	245,5	3,0	154,0	7,2
	P	89,1	232,9	8,5	56,0	6,0
Year	PM	549,1		—		51,9
	P	415,2		—		37,4

Rainfall and temperature data for Punda Milia and Pafuri are illustrated in the climatic diagrams in Figure 4 (Walter and Lieth, 1960; Reparticao tecnica de estatistica, 1961). The perhumid period, when the monthly rainfall exceeds 100 mm, occurs from the end of December to the middle of March at Punda Milia, but such a period is not experienced at Pafuri. The Punda Milia area has a more humid climate and this is ascribed to the higher humidity and light orographic rainfall which occur more commonly against the escarpment and the south and southeastern side of the Soutpansberg. The mean annual rainfall at Sibasa, approximately 60 km southwest of Punda Milia is 1 163 mm whereas Messina, north of the Soutpansberg has a mean annual rainfall of only 348 mm (Table 3).

TABLE 3.

The mean annual rainfall and mean number of rainy days per year at a number of weather stations in the vicinity of the Punda Milia—Pafuri—Wambiya area (Weather Bureau, 1954; Farrell, 1968)

Weather Station	Mean annual rainfall (mm)	Mean number of rainy days per year	Height above sea level (m)	Observation period (years)
Messina	348,0	44,0	549	41
Shingwidzi	410,0	42,6	215	11
Pafuri (Mozambique)	415,2	37,4	290	48
Sabi Valley	446,3	—	460	—
Nuanetsi	459,5	—	482	—
Phalaborwa	475,5	47,3	406	43
Punda Milia	549,1	51,9	462	41
Giyani	572,1	44,0	610	9
Triangle	622,0	—	425	—
Louis Trichardt	732,0	75,0	961	41
Levubu	954,1	53,0	610	17
Chipinga	1 118,1	—	1 142	—
Sibasa	1 163,0	66,0	739	49

Thunderstorms frequently occur in the study area and in a 24 hour period as much as 216 mm and 96,6 mm rain have been recorded for Punda Milia and Pafuri respectively. More than 80 % of the total annual rainfall occurs from October to March.

At Punda Milia and Pafuri the cloud cover at 08h00 is highest during February and March and during November and December respectively. According to Van der Schijff (1957) Punda Milia experiences an average of 124,4 days per year with 90 % cloud cover.

Hail seldom occurs and the study area is generally regarded as being frost-free although frost may sporadically occur in low-lying areas. During late summer drizzle is often experienced and dew is regularly formed on clear windless nights.

Biotic factors

The influences of man in the study area include artificial water provision, population control of larger mammals, disease control, tourism, introduction of exotic plants, erection of game proof fences, making of fire breaks, building of tourist roads and aerodromes and the implementation of veld fire policies (Van Wyk, 1975). The grazing and browsing of large mammals, such as buffalo and elephant, sometimes have a visible effect on the vegetation.

METHODS

Considering the size of the study area (1 586 km^2) and the heterogeneity of the vegetation it was decided to classify the vegetation on a partly subjective basis using the Braun-Blanquet method (Werger, 1974). By using this method the internal variations and interrelationships between groups of relevés can be presented in a simple way (Coetzee, 1972). The size of the quadrat which was used for the survey of the herbaceous component was 10 m × 20 m (Coetzee and Gertenbach, 1977). The herbaceous component includes all grasses and forbs irrespective of height and semi-woody dwarf shrubs of less than 1 m height.

For the structural analysis of the woody vegetation the Variable Quadrant Plot method of Coetzee and Gertenbach (1977) was employed. This method was used to determine the woody species composition, their trunk diameters, growth forms and height classes and to calculate their maximum canopy spread in different strata, total apparent canopy cover* and number of individuals per hectare. The cover-abundance values of the woody component could also be determined by this method. The size of a quadrat was determined by the density of the vegetation at each sampling plot. The three growth forms of the woody component that were recognised are as follows: tree growth form = individual with a single stem; sparse shrub growth form = individual with two to four stems; shrub growth form = individual with more than four stems.

The following strata were investigated separately: $\leq 0{,}75$ m; $> 0{,}75 - 1{,}5$ m; $>1{,}5 - 2{,}5$ m; $> 2{,}5 - 3{,}5$ m; $> 3{,}5 - 5{,}5$ m and $> 5{,}5$ m. These strata were then termed the 0,5 m; 1 m; 2 m; 3 m; 4–5 m and > 6 m strata respectively.

Homogeneous physiographic-physiognomic areas were mapped on 1: 30 000 aerial photographs. A total of 196 relevés were sampled representing an average density of one relevé for approximately 8 km^2. The Sandveld and *Colophospermum mopane* communities were analysed floristically as well as structurally, whereas the Hygrophilous communities were only analysed floristically by means of the Braun-Blanquet method. The descriptive phrase included in the name of each community is based on the physiognomic vegetation classification of Tinley (1969).

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*Overestimate due to overlapping canopies possible.

RESULTS AND DISCUSSION

During this study (Van Rooyen, 1978) the vegetation of the Punda Milia-Pafuri-Wambiya area (Fig. 5 and Table 4) was classified into the following communities.

1. Hygrophilous communities,
2. Sandveld communities,
3. *Colophospermum mopane* communities

In this paper only the Hygrophilous communities are discussed. In part 2 and part 3 of this series the Sandveld and the *Colophospermum mopane* communities respectively will be dealt with.

In Figures 2, 3 and 5 the strong correlation between the geology, soils and vegetation in the study area is shown.

THE HYGROPHILOUS COMMUNITIES

The Hygrophilous communities are found mainly on alluvial soils along rivers and streams. These sandy clay loam to clay soils have a neutral to alkaline pH, with a normal to high soluble salt concentration especially in the vicinity of pans or depressions. Carbonates are often present in these soils.

Two vegetation units were recognised:

1. The *Lonchocarpus capassa—Panicum meyerianum* tree savanna
2. The Pan communities

The units differ in terms of structure as well as floristic composition. In the pans themselves the absence of trees and shrubs in the pans is conspicuous while the presence of species such as *Cyperus* spp., *Nymphaea capensis, N. caerulea, Ottelia exserta* and *Paspalidium obtusifolium* characterise the Pan communities.

The *Lonchocarpus capassa—Panicum meyerianum* tree savanna (1) was divided into four communities:

1.1 The *Acacia borleae—Ischaemum afrum* shrub thicket
1.2 The *Combretum imberbe—Fuirena pubescens* open tree savanna
1.3 The *Acacia albida—Ficus sycomorus* riverine forest
1.4 The *Acacia xanthophloea—Panicum meyerianum* open tree savanna

Community 1.1 is characterised by species group S (Table 4) and the presence of *Setaria sphacelata, Ischaemum afrum* and *I. brachyatherum* in this community as well as in the other Hygrophilous communities suggests that these communities are related. Community 1.2, 1.3 and 1.4 are characterised by species group T, U, and V respectively. Species group V is well represented in all the Hygrophilous communities and confirms the relationship between these communities (Table 4). The absence of several species belonging to species groups S, T and U is important in the characterisation of community 1.4.

The salient habitat features of community 1.1 is a heavy clay soil with a well-developed blocky structure while community 1.4 is characterised by a soil with a high pH and high soluble salt concentration.

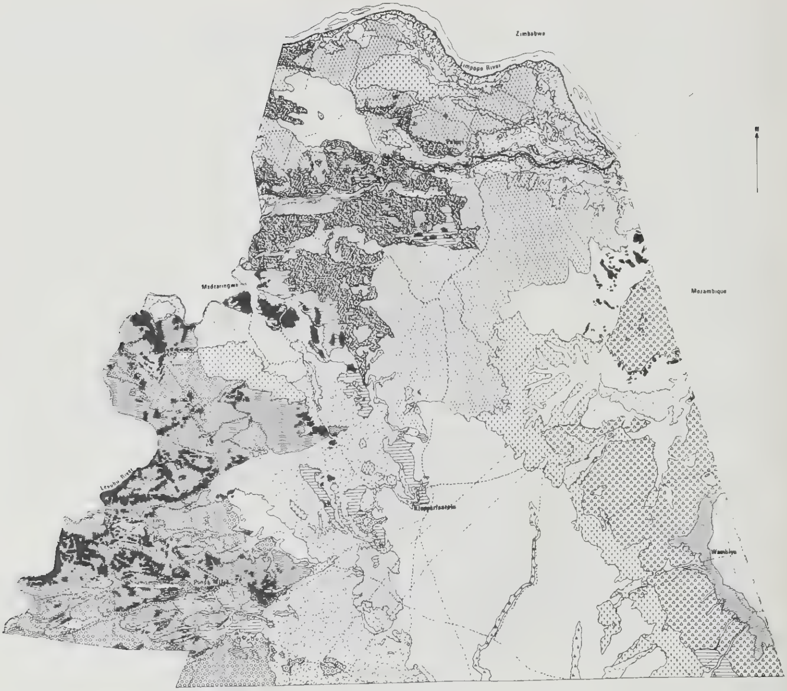

FIG. 5.
Vegetation map of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park.

1.1 The *Acacia borleae—Ischaemum afrum* shrub thicket

This community is found at approximately 400 m above sea level on the plains west of Mandadzizi (Figs 5 & 6). Although this community is not found along rivers or streams, the poorly drained and sometimes waterlogged, dark heavy clay soil in the area where it occurs, favours the development of a vegetation type with affinities to other Hygrophilous communities.

The fine textured clay soil has a brown-grey to brown-black colour and is usually deeper than 1 m. The topsoil has a well-developed blocky structure and is moderately to strongly alkaline, with a pH between 8,3 and 8,7. The soil has a moderate to high soluble salt concentration and carbonates are present.

LEGEND

Scale 1:460 000

○ BURKEA AFRICANA–PSEUDOLACHNOSTYLIS MAPROUNEIFOLIA TREE SAVANNA

BAPHIA MASSAIENSIS–GUIBOURTIA CONJUGATA THICKET

░ BAPHIA MASSAIENSIS–GUIBOURTIA CONJUGATA THICKET

▤ BAPHIA MASSAIENSIS–XYLIA TORREANA TREE SAVANNA

△ XERODERRIS STUHLMANNII–COMBRETUM APICULATUM TREE SAVANNA

⁝ TERMINALIA SERICEA–POGONARTHRIA SQUARROSA TREE SAVANNA

KIRKIA ACUMINATA–AFZELIA QUANZENSIS–COMBRETUM APICULATUM TREE SAVANNA

▦ KIRKIA ACUMINATA–AFZELIA QUANZENSIS TREE SAVANNA

≋ COMBRETUM APICULATUM–KIRKIA ACUMINATA TREE SAVANNA

■ ANDROSTACHYS JOHNSONII–CROTON PSEUDOPULCHELLUS DRY FOREST

× ROCKY OUTCROP COMMUNITY

▓ MIXED ROCKY OUTCROP COMMUNITY AND ANDROSTACHYS JOHNSONII–CROTON PSEUDOPULCHELLUS DRY FOREST

COLOPHOSPERMUM MOPANE–ACACIA TORTILIS–UROCHLOA MOSAMBICENSIS TREE SAVANNA

° ACACIA TORTILIS TREE SAVANNA

⁘ ACACIA SENEGAL SHRUB SAVANNA

● SALVADORA ANGUSTIFOLIA SHRUB SAVANNA

LEGEND

Scale 1:460 000

⁂	COLOPHOSPERMUM MOPANE–EUCLEA DIVINORUM–ENTEROPOGON MACROSTACHYUS TALL TREE SAVANNA
▩	COLOPHOSPERMUM MOPANE–COMMIPHORA GLANDULOSA–SEDDERA CAPENSIS OPEN TREE SAVANNA
░	COLOPHOSPERMUM MOPANE–ENNEAPOGON SCOPARIUS SHRUB SAVANNA
▒	COLOPHOSPERMUM MOPANE–THEMEDA TRIANDRA SHRUB SAVANNA
+ +	COLOPHOSPERMUM MOPANE–COMBRETUM APICULATUM–DIGITARIA ERIANTHA OPEN TREE SAVANNA
Z Z	DIABASE COMMUNITY
▦	ACACIA BORLEAE–ISCHAEMUM AFRUM SHRUB THICKET
S S	COMBRETUM IMBERBE-FUIRENA PUBESCENS OPEN TREE SAVANNA
▓	ACACIA ALBIDA–FICUS SYCOMORUS RIVERINE FOREST
	ACACIA XANTHOPHLOEA–PANICUM MEYERIANUM OPEN TREE SAVANNA
V V	ACACIA XANTHOPHLOEA OPEN TREE SAVANNA
⸙ ⸙	SPOROBOLUS CONSIMILIS GRASSLAND
≋	PAN COMMUNITIES
-·-	INTERNATIONAL BORDERS
- - -	ROADS
≈	RIVERS

TABLE 4.

A constancy table of the plant communities of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park*

	COMMUNITIES																
	SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
A *Burkea africana*	5																
Fimbristylis hispidula	3			1	1	1						1					
Andropogon gayanus	3					1						1					
Holarrhena pubescens	3																
Bauhinia galpinii	3				1												
Ochna pulchra	2		1														
B *Baphia massaiensis*		5															
Grewia microthyrsa		3															
Combretum celastroides		3				1											
Hugonia orientalis		3	1														
Ptaeroxylon obliquum		2															
Pavetta catophylla		2															
Cleistanthus schlechteri		2															
Mariscus sp.		2															
Heinsia crinita	1	2															
Xylia torreana		1															
C *Xeroderris stuhlmannii*			3														
Aristida junciformis	1		2														
Aristida stipitata	1		3	1													
Indigofera inhambanensis	1		2														
Limeum dinteri			2	1									2				
Macrotyloma axillare			2			1											
Pavonia burchellii			2									1					
Balanites maughamii		1	2		1								2				
D *Terminalia sericea*	3	2	5	4													
Combretum collinum	3	2	4	3	1								3				
Tricholaena monachne	2	2	3	1	1			1	1	1		1					
Merremia tridentata	4	3	3	3			1	1									
Crotalaria sphaerocarpa	1	1	2	3	1			1			1	1					
Perotis patens	3	3	3	3													
Pteleopsis myrtifolia	3	3	2	1	1												
Eragrostis pallens	2	4	2	2													
Zygoon graveolens	1	2	3	3			1										
Aristida argentea	2	2	1	1													

The constancy value of a plant species in a community is indicated by the following symbols: 1 (1–20 %); 2 (>20–40 %); 3 (>40–60 %) 4 (>60–80 %); 5 (>80–100 %)

*The complete differential table can be found in Van Rooyen (1978).

		COMMUNITIES																
		SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
	Vitex amboniensis	1	2	1	1		1						1					
	Vangueria infausta	1	2	2	1													
	Striga asiatica	2	1		2													
	Xeromphis obovata	1	1		2													
	Hippocratea crenata		1		2	1												
	Acrotome inflata				2													
	Blepharis subvolubilis			1	2													
E	*Kirkia acuminata*			1	1	5				2			1					
	Rhoicissus revoilii		1		1	3	1											
	Croton gratissimus		2			3	2											
	Afzelia quanzensis					3	1											
	Bridelia mollis					2												
	Maytenus mossambicensis	1				2												
	Indigofera lupatana					1												
	Landolphia kirkii					1												
	Asparagus falcatus		1			1												
	Canthium huillense					1												
	Rhus leptodictya					1												
	Lagynias dryadum					1												
	Elephantorrhiza burkei					1								2				
	Brachylaena huillensis					1												
F	*Androstachys johnsonii*				1		5											
	Sporobolus panicoides					1	4											
	Croton pseudopulchellus	1				1	4											
	Commelina benghalensis				1	1	3		1				1					
	Achyranthes sicula						3											
	Setaria ustilata						2											
	Leptocarydion vulpiastrum				1		2											
	Cymbosetaria sagittifolia						2			1								
	Selaginella dregei						2											
	Panicum heterostachyum						2											
	Barleria galpinii						1											
	Panicum deustum						1					1						
	Merremia pinnata						1											
	Cyperus amabilis		1				1											
G	*Pellaea viridis*	2				3	2											
	Pellaea calomelanos					2	2											
	Phyllanthus reticulatus				1	2	2		1		1							
	Corchorus longipedunculatus					1	1											
	Xerophyta retinervis					1	1											
	Cleome monophylla					1	1											
	Xerophyta equisetoides					1	1											

		COMMUNITIES																
		SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
H	*Combretum zeyheri*	3	2	1	3	3	1											
	Borreria scabra	1	2	3	1	1	2											
	Pogonarthria squarrosa	4	2	2	3	2	1		1				2					
	Strychnos decussata	1	2	1	1	1	1											
	Pseudolachnostylis maprouneifolia	5	1	1	2	2												
	Hexalobus monopetalus	2	3	1	1	2												
	Strychnos madagascariensis	3	2	4	3	3			1		3		1					
	Ipomoea magnusiana	2	2	4	2		2	1	1				1					
	Guibourtia conjugata	2	5	2		2												
	Rhynchosia resinosa		2	3	1	2				1								
	Triumfetta pentandra	1		1	2	1	2		1									
	Diplorhynchus condylocarpon	4			1	3	1											
	Alchornea laxiflora	1	4			2	1											
	Monodora junodii	2	2		1	3	1											
	Celosia trigynia	1	2			2	2		1									
	Waltheria indica	2	2		2	3	1		1	1			2					
	Hymenocardia ulmoides	2	2			3	1											
	Cassia absus	1			2	1	1											
	Blepharis maderaspatensis	1			1	2	2											
	Tephrosia elongata	2	1	2	1	1			1									
	Rhynchosia venulosa	1	1	2		1	1											
	Artabotrys brachypetalus	1	1	1	1	2						1						
	Agathisanthemum bojeri	2	2		1	1			1									
	Tephrosia longipes	2		1	1	1							1					
	Crabbea velutina	1		2		1	1		1					2				
	Hippocratea longipedunculata		1	1	1	1												
	Ximenia caffra	1			1													
	Ozoroa paniculosa	1			1	1						1						
	Ozoroa engleri			1	1													
I	*Urochloa mosambicensis*				1			5	1		1	1	2			4	2	
	Chloris virgata				1			4	1	1						2		
	Acacia tortilis							3	1								2	1
	Salvadora angustifolia							2		1								
	Boerhavia diffusa							2										1
	Azima tetracantha							2										
	Alternanthera pungens							1										
	Trianthema triquetra							1										
	Setaria verticillata							1										
	Acacia senegal					1		1										
	Cyathula crispula							1										
J	*Ximenia americana*			1	1			1	4									
	Enteropogon macrostachyus					1	2	1	3	1								

		COMMUNITIES																
		SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
	Tetrapogon tenellus							1	2									
	Chloris roxburghiana							1	2									
	Acacia grandicornuta							2	1									
	Amaranthus thunbergii							1	1									
K	*Commiphora glandulosa*					1		2	1	3		1						
	Abutilon fruticosum					1	1	2	2	2								
	Ecbolium revolutum							2	2	2								
	Sporobolus smutsii	1			1	1		2	1	1								
	Thilachium africanum				1			2	1	1				2				
	Corbichonia decumbens							1	1	2								
	Sporobolus fimbriatus								1	1								
	Aristida rhiniochloa								1	1								
L	*Enneapogon scoparius*										5							
	Euclea schimperi				1						4							
M	*Terminalia prunioides*							1	3	2	3							
	Maerua parvifolia				2	1		3	3	2	1			2				
	Seddera capensis							1	2	3	5	1	1					
	Elytraria acaulis								2	2			1					
	Zanthoxylum capense							1	1	2	2							
N	*Themeda triandra*								1			5		2				
	Neorautanenia amboensis								1	1		4						
	Setaria woodii							1	1	1		3						
	Urochloa brachyura								1			2						
	Panicum coloratum											2			3			
O	*Heteropogon contortus*	1				1			1	2	4	4	2	2		2		
	Bothriochloa insculpta							1	2	3		4		2		2		1
	Phyllanthus maderaspatensis								1	2	2	1	1					
	Fingerhuthia africana								1	2	3	1	2					
	Indigofera heterotricha								1	2	1	2	1					
	Sorghum versicolor								1	2		3	1					
	Heliotropium strigosum				2					2		2	1					
	Oropetium capense								1	1	1	1	1					
P	*Colophospermum mopane*				2	1		3	5	5	5	5	5		5	4		
	Euclea divinorum	1			1			1	3	1	2		1		5	3		
	Aristida congesta subsp. *barbicollis*				1			1	2	3	2	3	2					
	Neuracanthus africanus					1		1	2	4	1	1	2					
	Barleria lancifolia					1		1	2	2	2		1					
	Eragrostis rigidior		1		1	1		1	1		2	2	1					

		COMMUNITIES																
		SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
	Eragrostis superba							1	1	1	2	4	1					1
	Combretum hereroense					1			1	1	1	1		3		2		1
	Dicoma tomentosa							1	1	1		1	1					
	Dalechampia galpinii								1	2								
	Aptosimum lineare								1	2								
	Sterculia rogersii					1				1	2		1					
Q	*Combretum apiculatum*	2	2	5	4	5	1	1	1	5	4	2	5					
	Aristida congesta subsp. *congesta*	1	2	3	3	2	2	3	4	5	5	3	3					
	Indigofera vicioides	1	3	1	1	1	1	1	2	3	4	2	2	2				
	Cissus lonicerifolius	1	2	2	2	1	1	1	1	3	1	2	2					
	Hermannia glanduligera	3	2	1	3	2	1	1	1	1		2	1	3				
	Rhynchosia totta	3	1	2		1	1	1	1	3	3	2	2	3				
	Phyllanthus burchellii	1	5	3	1	1	3		1	3		1	2	2				
	Hibiscus engleri	2	2	2	2	2	2	2	1		1	1	1			2		
	Brachiaria nigropedata	2	3	1	3	1	1		1	1		2	2					
	Vigna unguiculata	3	2	4	4	1	1	1	1			2	2					
	Commelina africana	2		2	1	1	1	2	1			1	1					
	Acalypha indica	1		1	2	1	1	2	1	2	2	1	1	2				
	Boscia albitrunca	1	1	2	3	2	1	1	1	1			2					
	Commelina erecta	2	3	1	2	2	1	2	1	1			2					
	Monechma monechmoides		1	3	2	1	2	1	1	3		1	1					
	Enneapogon cenchroides	1		1	3	2	1	3	4	5	2	2	2					
	Phyllanthus pentandrus	1		1	1	1	1	1	2	1	4	1	3					
	Tephrosia polystachya	1	2	5	3	1	1		1	3	3	2	3					
	Cassia abbreviata	1	1	1		1	1			1		1	1					
	Schmidtia pappophoroides	2	2	4	4	1			2	2		3	4					
	Hibiscus sidiformis		1	1	1	1	2	1	1	2			2					
	Kyphocarpa angustifolia	1	1	1	1	3			1	2	1		2					
	Grewia bicolor	1		2	2	2	1	3	4	4	4	2	3	2				
	Dalbergia melanoxylon	2		4	3	1		1	1	1	4	3	2					
	Pseudobrachiaria deflexa		2			1	3	2	1	3		1	1					
	Pupalia lappacea	1			2	2	3	3	1	2				2				
	Evolvulus alsinoides	1	1	1	2	2	1		1	3	2		1					
	Tragus berteronianus			1	1	1		3	1	1	1	1	1					
	Cassia mimosoides	1			2		1		1			2	1					
	Euphorbia polycnemoides	1			1	3	1		1	3	2	1	2					
	Crotalaria virgulata		1	1	1		1		2	1			2					
	Euphorbia tettensis	2		3	2				1	3	1	1	2					
	Maytenus heterophylla			1		1		1	1	1	4	1						
	Cucumis anguria				2		1	1	1	1		1		2				
	Corchorus asplenifolius	1			3		1	1		2	2	1	1	2	3			
	Lantana rugosa	2		1		1	1			1			2					
	Tricalysia allenii	1	1		1	2				1			1					

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
Ipomoea obscura				1		1	2	1	1		1	1					
Grewia monticola			3	1	1	1		1			1						
Mundulea sericea	1		1	1	1				1		1						
Cymbopogon excavatus					1				1	1	2	1	3		2		
Markhamia acuminata				2	1				1		1	1					
Gardenia resiniflua				1	1	1	1	1	1								
Justicia protracta	1							1	1								
Barleria affinis					1				1								
Stylochiton natalensis	1				1	1		1									
Eragrostis curvula				1				1				1					
Ipomoea pes-tigrides	1	2		1			1	1									
Zornia diphylla	1	2		1	1				1			1					
Clerodendron ternatum	1		1	1				1	1	1	1	1					
Justicia flava					1		1	1				1					
Manilkara mochisia	1			1	1			1									
Rhynchosia minima	1							1			1	1					
Eragrostis heteromera				1			1		1								
Grewia hexamita		1	1	1	1	1			1		1		2				
Gisekia africana				1			2				1						
Commiphora edulis					1	1			1								
Anisotes sessiliflorus		1			1		1	1	1								
Cardiospermum halicacabum					1			1									
Aspilia mossambicensis	1								1			1					
Dactyloctenium aegyptium				1			1										
Polygala wilmsii	2		1		1				1		1						
Calostephane divaricatum				1	1			1	1								
Hermbstaedtia odorata	1							1		1		1					
Kyllinga alba	1					1		1			1	1					
Kohautia virgata	2						1	1		1		1					
Gardenia spatulifolia			1	1		1											
Cissus quadrangularis					1	1	1	1									
Stipagrostis uniplumis	1			1				1		1							
Eragrostis lehmanniana				1			1	1									
Leptactinia benguelensis		1	1		1	1		1									
Ipomoea crassipes											1						
Orthosiphon suffrutescens								1	1								
Grewia villosa					1	1	1		1		1						
Lippia javanica								1	1		1		2				
Merremia palmata											1	1					
Endostemon tenuiflorus									1	1							
R *Setaria holstii*													4	3	2		
Piliostigma thonningii													3				
Hyparrhenia rufa													3				
Helichrysum miconiifolium													3				

		COMMUNITIES																
		SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
	PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
	Ipomoea papilio						1							3				
	Acacia gerrardii											1		2				
S	*Acacia borleae*														5			
	Tetrapogon mossambicensis								1						5			
	Cephalocroton mollis											1			5			
	Ruellia patula				1			1	1	1		1	1		5			
	Brachiaria erucaeformis														3			
T	*Sesbania sesban*															4		
	Fuirena pubescens															3		
U	*Acacia albida*																5	
	Ficus sycomorus																4	
	Acacia robusta																4	
	Trichilia emetica																4	
	Diospyros mespiliformis																4	
	Hypoëstes verticillaris																3	
	Abutilon angulatum																3	
	Tabernaemontana elegans	1				1											3	
V	*Setaria sphacelata*									1			1	2	3	3		3
	Ischaemum afrum														5	4		2
	Ischaemum brachyatherum														3	2		1
	Panicum meyerianum															4	3	4
	Echinochloa pyramidalis															3	2	2
	Acacia xanthophloea																3	1
	Sporobolus consimilis																2	2
	Xanthocercis zambesiaca																3	1
	Kigelia africana																2	1
	Cyperus fenzelianus																	2
	Croton megalobotrys																	1
	Chloris gayana	1																1
W	*Panicum maximum*	4	5	5	5	4	3	5	4	4	1	3	4	2		4	5	3
	Digitaria eriantha	5	4	5	5	5	2	1	3	4	4	5	5	2	3	3	4	
	Hibiscus micranthus	1	1	2	2	3	3	3	4	5	3	1	4			2		
	Lonchocarpus capassa	1	1		3	1	1	1	1			2		3		4	4	2
	Spirostachys africana	1	3	1	1	1		1	2							4		1
	Combretum imberbe				1			1	1	1	1	3	1	2		3	3	2
	Solanum panduraeforme	2			2	2	2	1	2	2	1	2	3			2		1
	Dichrostachys cinerea	2	3	1	3	2	1	1	1	2	2	2	3	4		2		1
	Combretum mossambicensis	1	2	2	3	1	1	1	1	2	1		2	2				1
	Acacia nigrescens	1			2	2		2	3	3	4	2	4	3		4		
	Securinega virosa		2	1	1	1		1	1	1		1	1		5			1

	COMMUNITIES																
	SANDVELD						COLOPHOSPERMUM MOPANE						DIABASE	HYGROPHILOUS			
PLANT SPECIES	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
Vernonia fastigiata	4			1	2	2	1	1	2	1	3	1		5			
Cenchrus ciliaris			1					1	2		2	1					1
Achyranthes aspera	1			1	1	3	1	1	1							5	1
Indigofera rhytidocarpa	1	1		2			3	1	1	2	1	1					
Lannea stuhlmannii		2	1	1			1	1	1		1	1			2		
Leucas glabrata	1		1	2	1	1	1	1	2								1
Melhania forbesii	1	1	3	2	1			2	1	1	1	2					1
Monechma divaricatum			1	2			1	1									
Sclerocarya caffra	1	1	2	1	1				1		1	1			2		
Rhynchelytrum villosum			1	2	1	2		1	2	3	1	1	2				
Commiphora mollis				2				1	2	2		1					
Becium obovatum				1		1	1	1	3			1					
Asparagus setaceus	1			1	1	2		2	1	1		1		3			
Corchorus kirkii		2	2	1	1			1	1		1	1			3		1
Tragia rupestris	1		1	1	1			1	1		1	2			2		1
Grewia flavescens		2		1	1	1		1								2	
Maytenus senegalensis				1									2				1
Leonotis nepetifolia	2			1	1	1							2				1
Pterocarpus rotundifolius											1		2				
Ceratotheca triloba				1			1		1		1				2		
Barleria transvaalensis							1	1	1								
Peltophorum africanum	2				1			1					2				
Hemizygia bracteosa	1	1	2	1	1					1		1			2		
Albizia harveyi									1		1	1			2		
Abutilon guineense				1	1		1	1	1					2			1
Ziziphus mucronata					1		1	1		1		1					1
Melhania rehmannii					1	1		1			1						1
Cyperus sp.					1		1	1		1					2		
Ormocarpum trichocarpum								1			1		2		2		
Abutilon ramosum							1				1		2				1
Indigofera schimperi	1				1						1	1		3	2		
Cassia petersiana	1	1	1	1							1		2				

Trees in this shrub thicket are scarce and shrubs and sparse shrubs grow up to 3 m high. The most conspicuous species are *Colophospermum mopane* and *Acacia borleae*, although *Euclea divinorum* and *Securinega virosa* occur more widespread. The limited variety of woody plant species is diagnostic. The herbs have a low canopy cover and the most common species are *Ischaemum afrum* and *Tetrapogon mossambicensis*. A few other herbaceous species that are frequently found are *Cephalocroton mollis, Brachiaria erucaeformis, Ruellia patula, Corchorus asplenifolius* and *Panicum coloratum*. Widespread and abundant spe-

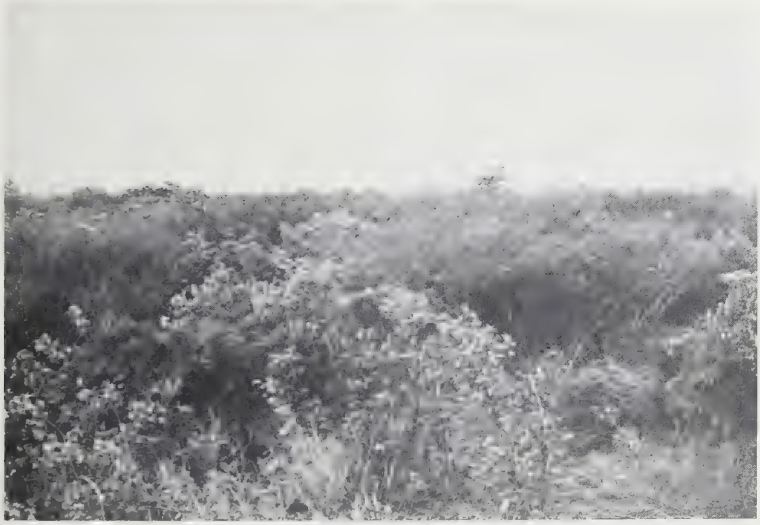

FIG. 6.
The *Colophospermum mopane—Acacia borleae* shrub savanna on the plains south of Klopperfontein.

cies such as *Panicum maximum* and *Digitaria eriantha* do not commonly occur in this community.

1.2 The *Combretum imberbe—Fuirena pubescens* open tree savanna

This community is situated at approximately 385 to 445 m above sea level along streams and near fountains in the Punda Milia area (Figs 5 & 7). The dark red-brown to brown-black soils which vary from a sandy clay loam to clay, are fine textured and usually more than 1 m deep. The topsoil has a moderately developed blocky structure and a friable consistency. The pH of the soil ranges from 6,0 to 6,8. The concentration of dissolved salts is moderate and in most cases a low concentration of carbonates is present in the soil. There is no striking difference between the habitat of this community and the other Hygrophilous communities except for a more neutral pH of the soil.

This community is characterised by sparsely distributed trees, a few shrubs and a grass stratum up to 1,5 m in height and the most striking species, such as *Combretum imberbe*, *Lonchocarpus capassa* and *Spirostachys africana* occur throughout the savanna. The most conspicuous shrubs are *Euclea divinorum*, *Dichrostachys cinerea* and *Albizia harveyi*. Common herbs include *Sesbania sesban, Fuirena pubescens, Ischaemum afrum* and *Panicum maximum*, while spe-

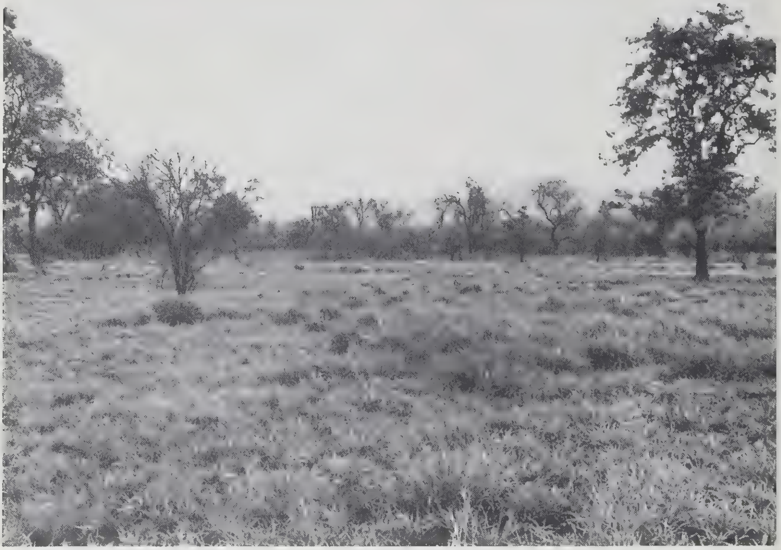

FIG. 7.
The *Combretum imberbe—Fuirena pubescens* open tree savanna along the streams near Punda Milia.

cies such as *Cyperus sphaerospermus, Ammania senegalensis, Lotononis solitudinus, Ageratum conyzoides* and *Gomphrena celosioides* have low constancy values.

1.3 The *Acacia albida—Ficus sycomorus* riverine forest

The forest occurs between 197 m and 215 m above sea level on alluvial soils on the banks of the Limpopo and Levubu Rivers and a few of their tributaries. It is also present around several of the perennial fountains west of Punda Milia (Figs 5 & 8).

The community occurs on fine textured dark red-brown to brown-black sandy loam, sandy clay or clay soils. The soil is more than 1 m deep and the topsoil is either apedal or has a weak blocky structure with a loose to friable consistency. The pH of the soil ranges from 7,2 to 7,6 and the topsoil contains a moderate concentration of soluble salts and is neutral or leached.

Trees in this community are up to 20 m high and sometimes form an almost closed canopy. In some places a dense shrub thicket up to 3 m develops beneath the trees. Physiognomically the most noteworthy species are *Acacia albida, A.*

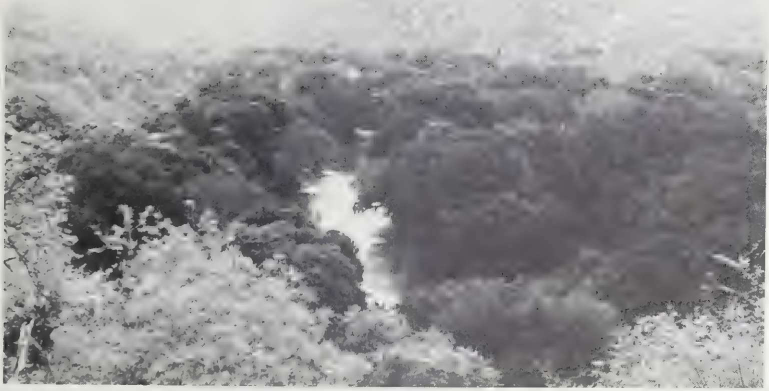

FIG. 8.
The *Acacia albida—Ficus sycomorus* riverine forest along the Levubu River.

robusta, Ficus sycomorus, Trichilia emetica and *Xanthocercis zambesiaca.* Conspicuous shrubs and sparse shrubs include *Grewia flavescens, G. caffra, G. inaequilatera, Pluchea dioscorides, Ficus capreifolia, Acacia schweinfurthii and Combretum paniculosa* subsp. *microphyllum.* The herbaceous component consists mainly of species favouring disturbed areas. According to Van der Schijff (1957) this can possibly be attributed to sporadic floods with the accompanying silt deposition. Common herbaceous species include *Panicum maximum* and *Digitaria eriantha* with high constancy values and *Abutilon angolense, Achyranthes aspera, Epaltes gariepina* and *Hypoestes verticillaris.*

Other widespread herbs are *Wissadula rostrata, Ageratum conyzoides, Cymbosetaria sagittifolia* and *Senecio inaequidens.*

The riverine forest is better developed and denser along the Levubu than along the Limpopo River. Where the Levubu cuts through the Waterberg and Cave Sandstone a number of species are found that are scarce along the Limpopo River, e.g. *Rauvolfia caffra, Ekebergia capensis, Breonadia microcephala, Strychnos potatorum, Syzygium guineense* and *Deinbollia oblongifolia.*

From Lanner Gorge to the confluence of the Levubu River and Limpopo River, characteristic vegetation zones have developed parallel to the Levubu

River. These zones are not always continuous and do not always have the same pattern, but in general four zones can be distinguished:

(a) In the water or at the water's edge species such as *Ficus capreifolia, Phragmites australis* and *Cyperus sexangularis* grow;

(b) high trees on the river bank, including species such as *Ficus sycomorus, Acacia albida, A. robusta, Garcinia livingstonei* and *Trichilia emetica*;

(c) semi-hygrophilous species further away from the river bank such as *Acacia xanthophloea, Combretum imberbe, Croton megalobotrys, Kigelia africana, Hyphaene natalensis, Lonchocarpus capassa, Xanthocercis zambesiaca, Albizia versicolor* and *Maclura africana*; and

(d) the *Acacia tortilis* zone which is the farthest from the water where species such as *A. tortilis, A. nilotica, Azima tetracantha, Capparis sepiaria* and *Xanthocercis zambesiaca* occur.

1.4 The *Acacia xanthophloea–Panicum meyerianum* open tree savanna

This community occurs between 200 and 415 m above sea level on the alluvial plains along the Levubu and Limpopo rivers (Figs 5 & 9).

The fine textured alluvial sandy clay loam, sandy clay or clay soils are brown-black to black and range from 600 to more than 1 000 mm in depth. The topsoil has a weak to moderate blocky structure and a friable to firm consistency. An outstanding feature of the habitat is the generally alkaline soils with a pH of up

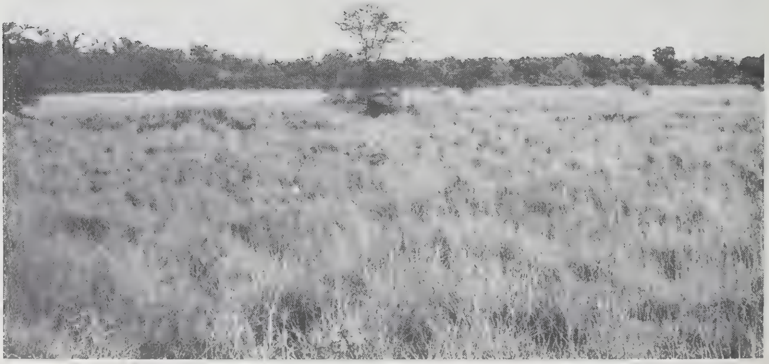

Fig. 9.

Flood plains with sparsely distributed trees like *Acacia xanthophloea* and *Sporobolus consimilis* as the most conspicuous grass species.

to 9,9 and with a high concentration of soluble salts. Carbonates are usually found in the soil.

Trees are from 6 to 15 m high and occur widespread throughout the flood plains and on the edge of the flood pans. In some places dense stands of a single species have developed, e.g. the *Acacia xanthophloea* forest near Crook's Corner. Dense stands of *Diospyros mespiliformis* as well as *Combretum imberbe* are also found. Although the shrub layer is not well developed it becomes 2 m high and the most conspicuous species are *Dichrostachys cinerea, Securinega virosa* and *Combretum mossambicensis*. Other woody species in this community include *Lonchocarpus capassa, Combretum hereroense, Croton megalobotrys, Maytenus senegalensis, Ziziphus mucronata* and *Spirostachys africana*.

Large parts of the flood plains are densely overgrown with grass species becoming up to 2 m high. The most conspicuous species are *Sporobolus consimilis, Setaria sphacelata, S. holstii, Panicum meyerianum, P. deustum, P. maximum* and *Ischaemum afrum*. Dense stands of only one or two of these species occur regularly.

In Figure 5 this community is subdivided into the *Sporobolus consimilis* grassland and the *Acacia xanthophloea* open tree savanna. According to Rattray and Wild (1955) the presence of *Acacia xanthophloea* in a region is indicative of the existence of a high water table and waterlogged soils.

2. Pan Communities

The pans along the Limpopo and Levubu Rivers are either filled during thunderstorms or are sporadically flooded. These pans are situated in the *Acacia xanthophloea–Panicum meyerianum* open tree savanna (1.4) and trees growing on the edge of these pans include species such as *Acacia xanthophloea, Combretum imberbe, Lonchocarpus capassa* and *Hyphaene natalensis*. In and around the pans in the Pafuri area the following species are characteristic:

Sporobolus consimilis
Panicum meyerianum
Ischaemum afrum
Setaria sphacelata
Cyperus fastigiatus
Cyperus corymbosus
C. sexangularis
C. immensus
C. distans
Nymphaea caerulea

In the Wambiya area the pans are filled by rain (Fig. 10) and the most striking species in and around the pans are:

Nymphaea capensis
N. caerulea
Ottelia exserta
Paspalidium obtusifolium
Neptunia oleracea
Bergia salaria
Epaltes gariepina
Cyperus difformis
Fuirena ciliaris
Vahlia capensis

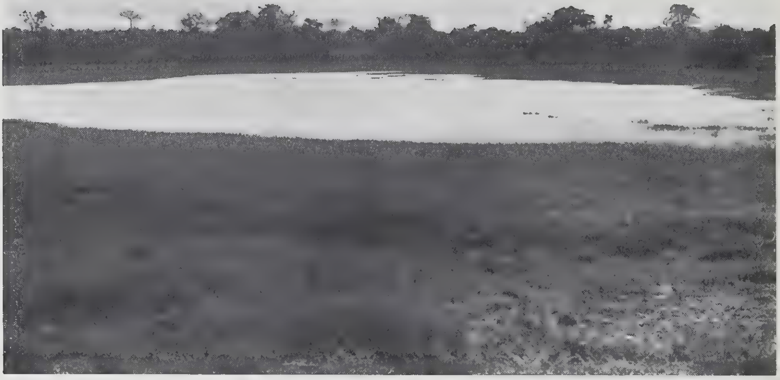

Fig. 10.
Machayi pan in the Wambiya area.

The vegetation in the immediate vicinity of the Wambiya pans differs markedly from the surrounding Sandveld vegetation and the most conspicuous species are:

Spirostachys africana
Combretum imberbe
Diospyros mespiliformis
Lonchocarpus capassa
Dalbergia melanoxylon
Dichrostachys cinerea
Euphorbia ingens
Ehretia amoena
Gardenia spatulifolia
Crossopteryx febrifuga

These species also occur on termitaria in the Sandveld regions.

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